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Comparative study of frequency spectrum and energy of electroretinogram oscillatory potentials (OPs) in mammals

Purpose: Oscillatory potentials (OPs) are high frequency, low amplitude wavelets embedded on the ascending limb of the electroretinogram (ERG) b-wave. In human, the bandwidth for OPs recording was recommended at 75~300 Hz. We studied the frequency spectrum and the energy of the OPs in mammals.

Methods: Albino (Balb/c) and pigmented (C57BL/6) mice, New Zealand White albino rabbits, cats, and rhesus monkeys were studied. Dark-adapted ERGs were recorded with a bandwidth range of 0.1~1000Hz. We removed the low frequency a- and b-wave contaminations and extracted the OPs digitally with a Butterworth bandpass filter. The extracted OPs were analyzed by Fast Fourier Transform (FFT) to estimate the power spectrum and then converted to a single-sided power spectrum. Summed OPs amplitude (μV), peak frequency power (analogous to power of mechanical vibration, in $(\mu V*sec)^2$) and band area energy (μV^2sec, numerical integration of the power spectrum) were measured.

Results: In frequency domain, albino and pigment mice have one major component at 105.8±10.27 (mean±STD) and 102.24±13.31 Hz respectively. Cats have two peaks at 69.4±3.47 and 133.15±3.89 Hz. Rabbits and monkeys show multiple peaks. In rabbit, the peaks are at 85.95±12.22, 114.91±13.35, 152.46±19.63 and 194.11±18.22 Hz. And in monkey the peaks are at 75.5±3.27, 137.87 and 161.63 Hz. For OPs power analysis, summed OPs amplitude, peak frequency power and energy are highly correlated. In these animals, mice have the highest OPs energy at 705±269.48 (mean±STD, μV^2sec, albino) and 508.46±178.05 (pigmented). The total OPs energies are 11.04±4.84 in cats, 6.01±2.96 in rabbits and 25.86±16.55 in monkeys.

Conclusions: 1. OPs frequency spectrum patterns are different between species. Frequencies of some OPs components are beyond the bandwidth range used in human study. Therefore we suggest adjusting the frequency bandwidth for different species. 2. Multiple frequency peaks may imply different mechanisms. 3. Mice have the highest OPs and may be a good model for OPs study.

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